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WORKPLAN TO EVALUATE FREE PRODUCT REMEDIAL STRATEGIES

L.E. Carpenter & Company

Wharton, New Jersey
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RMT®

Table of Contents

List of Tables

List of Figures

Section 1
Introduction

1.1 Background

Subsurface investigation and remedial action activities have been ongoing at the former L.E. Carpenter & Company (LEC) facility since the Administrative Consent Order was executed in 1986. Free product removal was identified in the 1994 Record of Decision (ROD) as Phase 1 of remediation for site groundwater, to be followed by Phase II, recovery and treatment of dissolved constituents in the groundwater once the immiscible product layer was removed. Current dissolved phase contaminants of concern in the groundwater are benzene, toluene, ethylbenzene, and xylenes (BTEX) and bis (2-ethylhexyl) phthalate (DEHP). Based on the analytical results of historical free product sampling conducted by both Roy F. Weston (WESTON) and RMT, Inc. (RMT), the free product layer is considered a major source of dissolved phase BTEX and DEHP contamination in shallow groundwater.

Free product recovery was initiated during the early 1990's, first with skimmer pumps in select wells, and then with enhanced fluid recovery (EFR) over a large number of wells in the free product zone. Since November 1997, RMT has been performing monthly EFR events from a network of 28 EFR wells by means of mobile vacuum source. Extracted free product and limited volumes of groundwater are transferred to an on-site 550-gallon aboveground storage tank for eventual off-site transportation and disposal. Current and historical free product extraction volumes range from 50 to 60 gallons of measurable free product per EFR event (600 to 720 gallons per year). Since initiation in November 1997, site EFR activities have removed approximately 3,188 gallons of free product (through the end of 3rd Quarter 2001).

In May 2000, RMT submitted the report entitled Free Product Volume Analysis. This report summarized the results of free product modeling and analysis, and concluded that a total volume of approximately 44,000 gallons of light nonaqueous-phase liquid (LNAPL) existed in the eastern portion of the site, of which 8,000 to 13,000 gallons are considered recoverable. Subsequently, based on a current EFR extracted volume to date of 3,188 gallons, approximately 4,800 to 10,800 recoverable gallons of LNAPL are thought to remain.

Over the past year to eighteen months, RMT has noted consistently low recovery volumes during each of the monthly EFR events. RMT has equated this to the small radii of influence created around each of the extraction wells during the EFR event, and extremely slow LNAPL recharge rates between each concurrent event. Evidence of the slow LNAPL recharge rates was most noticeable during first quarter 2001. Significant increases in the measurable thickness of

LNAPL was noted across the eastern portion of the site (March 2001), and was attributed to cancellation of both the January and February 2001 EFR events due to site access issues (snow cover). As outlined in various correspondence between RMT and the agency/department, RMT feels that a combination of both varying degrees of impermeable site geology, and the viscous nature of the LNAPL itself are causing inefficient LNAPL recovery rates.

As a result, RMT has raised concerns about predicting/modeling the effective and efficient LNAPL recovery of any in situ collection mechanism (i.e. trench, well network) without further physical and chemical evaluation of both the site subsurface and LNAPL itself. In addition, RMT also has concerns as to whether extraction of the modeled 4,800 to 10,800 gallons of recoverable LNAPL would be considered sufficient by both the agency and department in the event that residual LNAPL continually bled into the associated well network coupled with a proposal to institute a monitored natural attenuation (MNA) sampling protocol to address dissolved phase constituents in shallow groundwater. Subsequently, RMT proposed a conference call to raise these concerns and discuss the viability of various courses of action.

A conference call between RMT, the United States Environmental Protection Agency Region II (USEPA), and the New Jersey Department of Environmental Protection (NJDEP) was held on October 25, 2001. Participating in the discussions were Jim Dexter, Nick Clevett, Drew Diefendorf, Holly Herner, Laura Curtis and Eric Swanson of RMT; Gwen Zervas of NJDEP; and Stephen Cipot Andy Crossland of USEPA. During the discussions all three parties agreed that evaluating and implementing a more efficient and effective approach to managing the existing free-product plume needed to be expedited. RMT recommended fast-tracking a more aggressive remedial approach with a focus on ex-situ thermal treatment as the preferred remedial option. As additional data are needed to evaluate the viability of the ex-situ thermal option, RMT recommended collection of other data in the field to evaluate thermal treatment as well as data necessary to screen the viability of additional technologies, should moving forward with ex-situ thermal treatment not prove viable.

This workplan has been prepared by RMT on behalf of LEC in response to both discussions held during the October 25, 2001 conference call, and receipt of the comment letter from EPA and NJDEP dated August 23, 2001 regarding the document entitled Enhancement of Free Product Recovery (RMT, May 2001). As discussed on October 25, 2001, it is desirable by all parties that this screening and data gathering be accomplished as quickly as possible such that a preferred alternative can be implemented by the end of first quarter 2002. The three parties therefore agreed to preparation of this workplan to outline the scope of testing and data gathering to be conducted in forth quarter 2001.

1.2 Decision Analysis For Ex-situ Thermal Treatment

Three critical issues must be evaluated to determine whether thermal treatment should be selected as the remedial technology for this site: (1) treatability of the soils, (2) likelihood for approval of necessary permits, and (3) excavatability of the soils. Figure 1 presents a decision tree analysis of the combined technology of soil excavation with ex-situ thermal treatment. Soil excavation would be accomplished most easily, (1) if excavatability and stability of the soil are not problematic; (2) if groundwater influx is minimal and easily controlled; and (3) if any excess free product does not contaminate clean zones or backfill during excavation. Similarly, thermal treatment of excavated soils would be most easily accomplished, (1) if excavation rates are not so much greater than treatment rates such that storage becomes a problem, (2) if excess moisture can be effectively removed for thermal treatment to be cost effective, (3) if the process can remove the target products and byproducts to levels below treatment standards, (4) if process water can be easily handled, and (5) if off-gassing and air permitting hurdles could be overcome.

If any major limitations exist making either soil excavation or thermal treatment impracticable or too costly, other in situ or ex-situ technologies must be evaluated. In the interest of fast-tracking the implementation of a preferred alternative, RMT proposes to collect all data needed including that necessary to evaluate alternative technologies, should thermal treatment be determined infeasible.

1.3 Identification and Prioritization of Data Needs

Evaluation of the technical practicability of remedial technologies to address free product reduction or removal at the LEC site can easily be narrowed to a handful of in situ and ex-situ technologies. Evaluation of each of these technologies requires data on various physical and chemical characteristics of the subsurface and the soil and product to be treated. Figure 2 presents a matrix of potential technologies and the technical data and regulatory information needed. The data needed for the generic technologies that include containment, hydraulic control, groundwater extraction, and source removal are similar, and require geotechnical and hydrogeologic data as well as analytical and physical data on the free product. The data all relates to understanding the excavatability of soils in the subsurface, the ability to control groundwater during excavation, and the ability to extract and/or treat the free product. It should be noted that any evaluation of ex-situ treatment technologies would also require the analysis of this same data, in particular the ability to remove the soil for treatment.

If the thermal treatability test shows that ex-situ thermal treatment will accomplish our remedial goals, RMT will prepare a workplan for full-scale implementation. If thermal treatment does not prove to be viable, data collected based upon the tasks outlined in this workplan will be evaluated for selection of an alternate remedial technique.

Section 2
Proposed Scope of Work

To answer the important technical questions for selection of a remedial technology, we propose a field investigation with specific laboratory analyses and data collection. Visual information and soil and product samples for analysis will be obtained through the installation of test pits within the area of the free-product zone on the site. Data objectives for each task are outlined in Table 1. Specific tasks related to this data gathering, evaluation, and reporting effort are as follows.

Task 1 – Test Pit Installation, Field Testing and Soil Sampling

Three (3) test pits will be installed in areas indicated to have the greatest product thickness as shown on Figure 3. Each test pit will be excavated to depth sufficient (between 8 and 10 feet bgs) to expose any strata containing free product. Each pit will be constructed with a bench wall on one side at the four-foot depth. All excavated materials will be segregated by depth from excavation and any visual evidence of contamination. Soils above the water table suspected of lead contamination will be placed on one side of the pit for replacement as backfill. Excavated soils potentially contaminated with DEHP and BETX compounds will be placed on the bench wall. Later these will be incorporated into the lower part of the trench during backfilling.

Excavation of the trenches will be observed and directed by an RMT geologist. All excavations will be monitored with a PID and an explosimeter. The ability of the backhoe to penetrate the soil will be observed and any limitations or obstructions recorded. RMT will measure and document the stratigraphy observed and note the behavior of any free-product and/or groundwater encountered. Up to three (3) representative samples of any cohesive soils will be obtained by the geologist from the backhoe bucket at each pit, and tested for strength with a pocket penetrometer. Up to three (3) representative soil samples from each test pit will also be selected by the geologist for submittal to the RMT geotechnical laboratory. During excavation of each test pit, the infiltration of groundwater into the excavation will be visually monitored. If the test pits remain stable, each test pit will be left open overnight before they are backfilled. While each test pit is open, the infiltration of groundwater into the excavation will be visually monitored, and, if possible, measured by tape or rod. The sections of each test pit that are representative of product saturation will be identified. Up to six (6) five-gallon containers of product contaminated soil will be gathered from the backhoe bucket at each pit for bench-scale testing by selected technology vendors, for physical and chemical laboratory analysis, and other analysis, should thermal treatment prove infeasible.

If time permits, additional test pits may be excavated in the apparent source area to evaluate excavatability and the presence of any free product. These, however, will not be completed with product recovery wells.

Task 2 – Installation of Product Recovery Wells and Free Product Sampling

Once each test pit has been excavated, a 4-inch diameter, 3-foot long stainless-steel well screen and 6-foot long riser will be positioned in the pit to straddle the water-table surface. The pit will then be backfilled to one foot above the well screen with a select well-sorted washed stone. The remainder of the pit will then be backfilled to the surface with the stockpiled soil excavated from the shallow portion of the pit.

The water/product levels in each well will be monitored. These measurements will provide for assessment of potential volumes of groundwater to be controlled or recovered during remedial activities. Product thickness will be measured weekly for a minimum of three (3) episodes using a transparent disposable bailer. This will provide for assessment of enhanced fluid recovery by installation of collection trenches. Any product collected will be handled during quarterly EFR efforts. Samples of recovered product will be taken from each well during the next EFR effort and reserved for later submittal to analytical laboratories for analysis of physical and chemical parameters.

Task 3 - Soil Thermal Treatment Analyses

A minimum of three (3) five-gallon composite samples of contaminated soil will be shipped to a selected thermal treatment vendor for bench-scale testing. At a minimum, samples before and after thermal treatment will be analyzed for BTEX, DEHP, and daughter phthalate compounds. It may be necessary to evaluate the treated soil for the eight (8) RCRA metals.

This testing is anticipated to include effectiveness of contaminant reduction as well as measurement of potential off gases using a Combustion Emissions Monitor. The off-gases detected will define the type of air pollution controls needed during full-scale operation. Generally, the system operates with a bag house and thermal oxidizer. Options for addition of a scrubber or carbon adsorption to the off-gas treatment train are available, if needed.

If thermal treatment does not prove to be viable, other ex-situ as well as in situ treatment technologies may be evaluated.

Task 4 – Laboratory Analyses

Samples from the test pits will be collected for performance of physical and chemical testing. However, testing will be performed based upon priority. Geotechnical testing will be performed during the initial phase of this project to aid in the evaluation of excavation limitations and identification of controls that may be necessary to remove soils from the ground for ex-situ treatment. Should thermal treatment prove infeasible, additional testing (physical and chemical testing of free product and groundwater samples, and chemical soils testing) discussed in this section will be performed on an as needed basis.

Geotechnical Analyses- Up to three (3) soil samples obtained from each of the pits will be submitted to RMT's geotechnical laboratory for physical testing including; Atterberg limits, grain–size distribution, moisture content and drainability. These data will provide information to allow for evaluation of construction limitations including excavatability, trench stability, cut-off installation, and soil dewatering.

Product Physical Analyses - One free product sample from each test pit well will be collected and held. Should thermal treatment prove infeasible, the samples will be submitted to Saybolt Laboratories for analysis of specific gravity, viscosity, vapor pressure, surface tension, boiling point and flash point. These data will aid in the evaluation of in situ as well ex-situ treatment technologies, particularly those directed at thermally enhancing free-product removal.

Product Hydrocarbon Analysis – A free product sample collected from each test pit well will be submitted to Severn Trent Laboratories for identification of organic compounds to specifically include BETX, DEHP and daughter phthalate compounds. These data will provide information necessary to evaluate the effectiveness of potential treatment technologies and to predict the potential production of unwanted breakdown products.

Soil Metals Analysis – Up to three (3) representative soil samples from each pit will be collected and held. Should thermal treatment prove infeasible, samples will be submitted to Severn Trent Laboratories for analysis of iron, manganese and the eight (8) RCRA metals. These data will support evaluation of the potential for toxic by-products and the potential of clogging of soil pores resulting from the application of various in situ treatment technologies.

Task 5 – Evaluation and Report Preparation

Once vendor testing and analytical reports are received, RMT will determine whether ex-situ thermal treatment is a viable remedial option for this site. RMT will prepare a summary report for agency review. Should thermal treatment prove infeasible, RMT will conduct additional testing detailed in Task 4 and will identify the positive aspects as well as the limitations of the technology applications evaluated. RMT will prepare a ranked list of preferred alternative approaches. RMT will prepare a technology evaluation report for submittal to EPA and NJDEP summarizing the results of our evaluations and recommends for an expedient path forward. Should a thermal treatment not prove viable, RMT will propose immediate testing of alternative technologies as outlined in option Task 6. If ex-situ thermal treatment proves to be the preferred alternative RMT will recommend development of a detailed Remedial Action Work Plan to be implemented in early 2002.

Task 6 – Alternative Treatment Analysis

Should unacceptably high moisture content prove cost-prohibitive in the use of ex-situ thermal treatment, soil mixing using inert materials may be used. We will submit three (3) additional five gallon containers of contaminated soil reserved during test pits excavation to RMT's Applied Chemistry Laboratory to evaluate the effectiveness of solidification utilizing inert bentonite and Portland cement.

Two (2) additional five-gallon containers of contaminated soil collected from each test pit during excavation will be retained by RMT for potential analysis by other technology vendors, should ex-situ thermal treatment not prove viable. It is anticipated that these technologies would include in situ as well as ex-situ chemical oxidation, solvent and surfactant extraction, and soil washing technologies.

Section 3
Schedule

We anticipate completing the data-gathering portion of this project during November and December of 2001. We will perform data analysis and technology report preparation during January and February 2002 and prepare a detailed Remedial Action Plan for submittal by March 15, 2002.

Table 1
Free Product
Technology Screening Task Outline
L.E. Carpenter

TESTING PHASE	TASK OR ANALYSIS	OBJECTIVE
Task 1 – Test Pit Excavations (3 exploratory test pits)	1. Excavate test pits 2. Observe and Log Excavation, Trench stability and Site Stratigraphy 3. Select 3 sets of soil samples from each pit and collect in 5-gallon storage containers 4. Perform soil penetrometer tests	1. Determine geotechnical limitations on excavation and equipment 2. Determine hydraulic and product behavior of stratigraphic zones encountered 3. Provide sufficient representative volumes of soils and product samples for subsequent laboratory analyses
Task 2 – Product Recovery Tests (3 product recovery wells)	1. Backfill pits with approved soil and granular backfill and install screen and riser 2. Install product skimmer 3. Pump free Product from each pit well 3 times over two-week period.	1. Provide sufficient sample volume for laboratory analysis of free product 2. Determine if trench and sump construction will augment free-product recovery
Task 3 – Soil Thermal Testing	1. Submit two five-gallon samples of contaminated soil to thermal treatment vendor for bench-scale testing of ex-situ thermal treatment	1. Determine if thermal treatment can effectively reduce or destroy contaminants to levels below regulatory limits 2. Determine if undesirable gasses, or other toxic byproducts will be produced 3. Determine if excess moisture will require removal or solidification efforts
Task 4a– Geotechnical Laboratory (2 samples each pit)	Analyze soil samples for: 1. Product Saturated/dry weight 2. Grain-size distribution 3. Atterbergs 4. Moisture contents	1. Determine drainable percentage of free product 2. Determine relative permeability 3. Determine trench stability

Table 1
Free Product
Technology Screening Task Outline
L.E. Carpenter

TESTING PHASE	TASK OR ANALYSIS	OBJECTIVE
Task 4 b – Soils Metals Analysis (2 samples each pit)	Analyze soils for content of: 1. Mn and Fe 2. RCRA Metals	1. Determine soil clogging potential 2. Identify any release of toxic metals 3. Determine treatability of soil
Task 4 c – Product Physical Analyses (Saybolt Labs) (1 product sample per pit)	Analyze free-product samples for: 1. Density 2. Viscosity (@ 4 temperatures) 3. Surface Tension 4. Vapor Pressure 5. Surface Tension 6. BP and FP	1. Support in situ and ex-situ thermal treatment evaluations 2. Determine free product recovery rates and modeling data input
Task 4d – Free-product chemical Analysis (1 product sample per well) (Independent Laboratory)	Analyze free product for: 1. VOCs 2. SVOCs 3. Hydrocarbon Analyses	1. Determine hydrocarbon make up of product 2. Identify potential by-products 3. Provide criteria for selection of Treatment Technologies

L.E. CARPENTER - FREE PRODUCT
TECHNOLOGY EVALUATION DECISION ANALYSIS

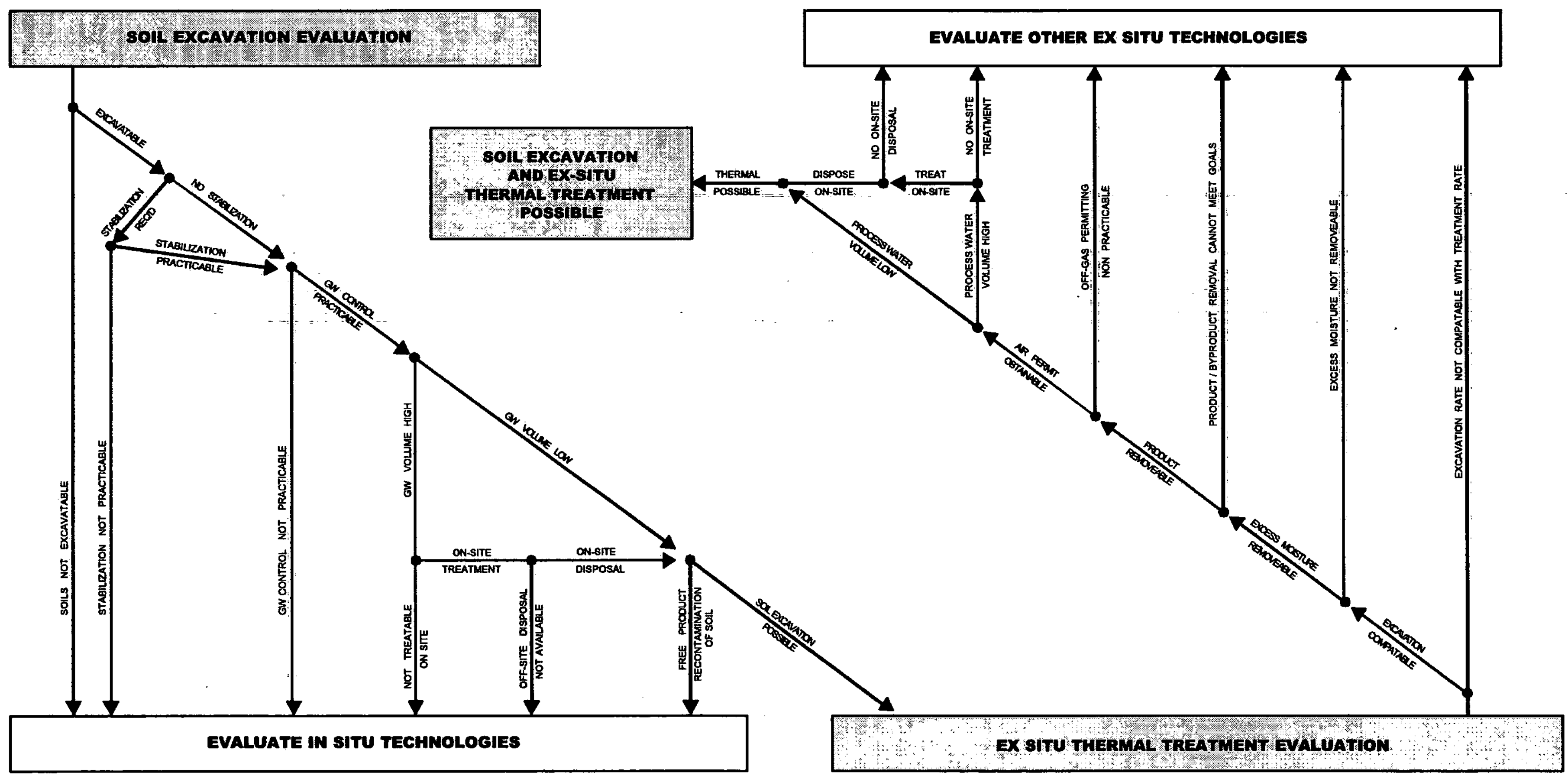


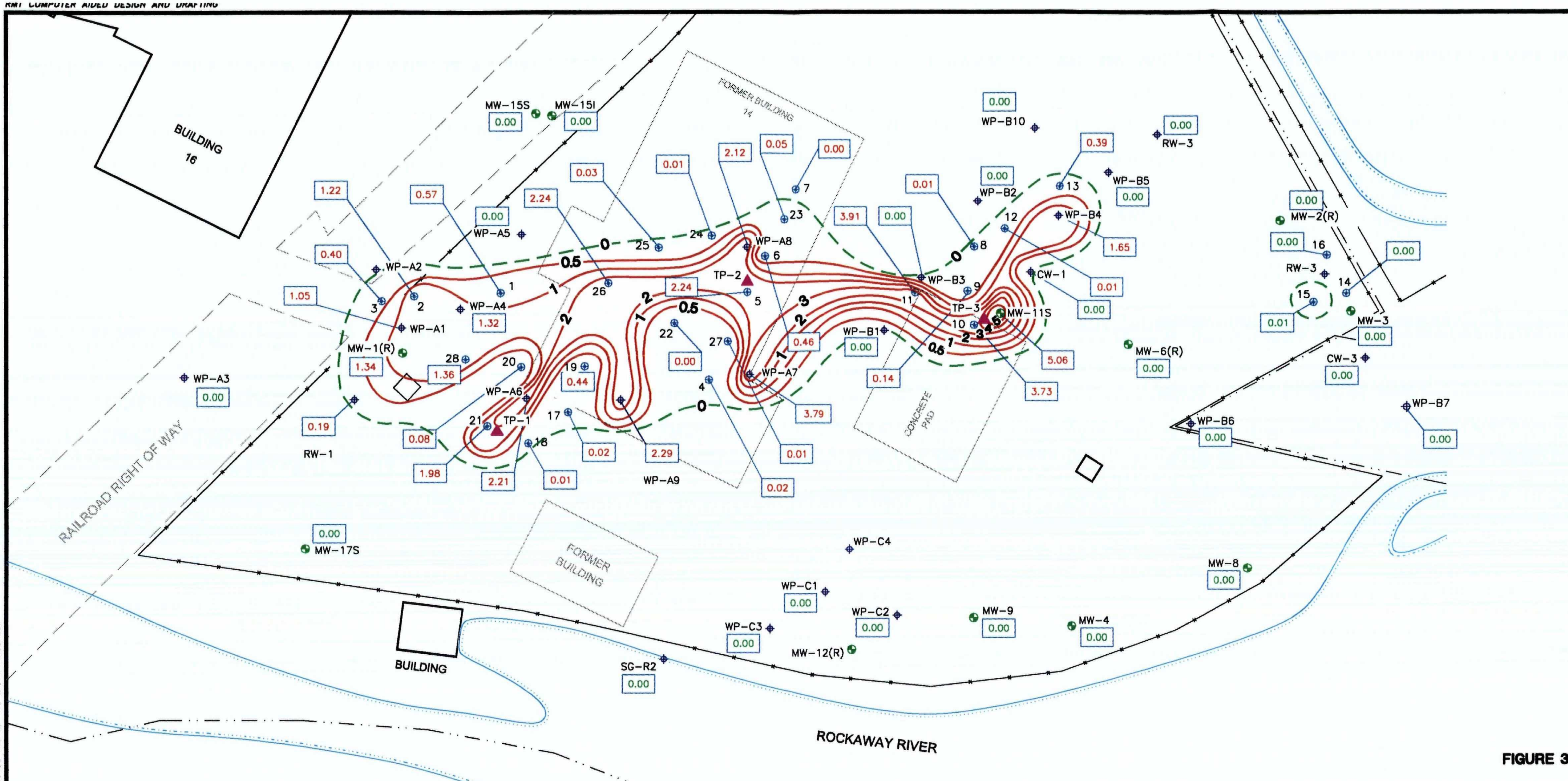
FIGURE 1

Figure 2
Matrix of Potential Remediation Technologies and Associated Technical Data Needs and Concerns
L.E. Carpenter

Technology	PHYSICAL AND CHEMICAL DATA NEEDS FOR FEASIBILITY																				REGULATORY CONCERNS						HEALTH & SAFETY
	Penetrability	Atterbergs	Shear Strength	Drainability	Stratigraphy	Grain size	Permeability	Fluid Yields	Moisture content	Volumes	Water Table	Viscosity	Vapor Pressure	BP and FP	Solubilities	Surface Tension	Org. Compounds	Inorg. Compounds	Off Gasses	By Products	Treated Water Disposal	Treated Soil Disposal	SW/GW NPDES	AIR	STORAGE	Other ARARS	Health/Safety
Containment	●				●	●	●				●																
Hydraulic Control	●				●	●	●	●	●		●																
GW Extraction	●			●	●	●	●	●		●	●						●	●			●		●			●	●
Source Removal																											
Soil Removal	●	●	●	●	●	●		●	●	●	●						●	●				●			●	●	●
Product Recovery					●		●	●	●	●	●	●	●	●		●	●				●					●	●
GW Recovery					●	●	●	●		●	●						●				●					●	●
In situ Treatment and mobilization																											
Chem Oxidation					●	●	●			●	●		●				●	●	●	●				●		●	●
DUS – hydr Pyrol					●	●	●			●	●			●			●		●	●				●		●	●
Surfactant/Solvent					●	●	●			●	●	●			●	●	●		●	●						●	●
Thermal					●	●	●	●		●	●	●	●	●			●	●		●				●		●	●
Ex-situ Treatment																											
Chem Oxidation									●	●				●			●	●	●	●	●		●	●	●	●	●
Thermal Desorption									●	●				●			●	●	●	●	●		●	●	●	●	●
Thermal Destruction									●	●			●	●			●	●	●	●	●		●	●	●	●	●
Soil Washing						●			●	●		●			●	●	●	●	●	●	●		●		●	●	●
Dewatering				●		●			●	●											●		●		●	●	●
Hauling				●																	●				●	●	●
Soil Disposal						●											●	●				●			●	●	●

Note that all ex-situ treatment technologies also require data listed for removal technologies and groundwater control.

RMT COMPUTER AIDED DESIGN AND DRAFTING



LEGEND

SURFACE WATER FEATURE

PROPERTY LINE

FENCE

1 — APPARENT PRODUCT THICKNESS CONTOURS (FT)

0 — — APPROXIMATE OUTER LIMIT OF FREE PRODUCT

0.00 NO MEASURABLE PRODUCT

1.22 PRODUCT THICKNESS MEASURED IN WELL (FT)
(Measurements collected at monitoring wells and well points on July 24, 2001 by STL Edison)
(Measurements collected at EFR wells on July 27, 2001 by CEMCO)

MW-13S MONITORING WELL

MW-24 ABANDONED WELL

RW-2 RECOVERY WELL

CW-3 CAISSON WELLS

WP-B7 WELL POINTS WITH ELEVATION

TREATMENT BUILDING

13 ENHANCED FLUID RECOVERY WELL (EFR)

TP-1 TEST PIT LOCATION

N

0 50' 100'

SCALE IN FEET

L.E. CARPENTER
WHARTON, NEW JERSEY

TEST PIT LOCATIONS

DRAWN BY:	LUCIDOS	PROJECT NUMBER:	3868.25
CHECKED BY:	JDD	FILE NUMBER:	38682508.DWG
APPROVED BY:	JDD	DATE:	NOVEMBER 2001

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PLOT DATA
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